# Prescribing costs in UK general practice: the impact of hard budget constraints

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The development of an internal market in UK public sector health care has introduced hard budget constraints for those general practitioner purchasers who elect to hold their own budgets or 'funds'. Prescription medicines constitute an element of the fundholder's budget and a theoretical model is developed to explain how hardening constraints might be expected to impact upon prescribing decisions. The model is based on a trade-off between prescribing and budget surplus and it predicts, inter alia, that both the prescribing costs and volume of medicines prescribed by fundholders will be lower than for non-fundholders. A reduction in X-inefficiency is also predicted, manifested as a higher rate of generic prescribing and the use of computerized prescribing management. The model is found to be consistent with the observed facts in one English health authority (Lincolnshire).

## INTRODUCTION

At present, the United Kingdom devotes approximately 6% of its annual gross domestic product to public health care, via the National Health Service (NHS). After staffing, drugs constitute the largest single NHS expenditure item, at around 10% of total NHS spending. In turn, 80% of drug expenditures originates from the primary care sector and is accounted for by medicines prescribed by general practitioners (Office of Health Economics, 1995). Until relatively recently, controls over the prescribing of medicines by general practitioners (GPs) have been rudimentary (Audit Commission, 1993) and the 1989 Working for Patients White Paper made explicit reference to this as an issue of concern: 'Expenditure on medicines has grown on average by four per cent a year above the rate of inflation over the past five years' and the cost of the drugs is 'more than the cost of the doctors who wrote the prescriptions' (CM 555, 1989 p. 57). The prescribing problem as perceived was not confined to the magnitude and growth of spending on prescribed medicines, because there was very clear evidence of substantial disparities in the cost of GP prescribing between the various health authorities at the local level. Moreover, practice-by-practice variations evidently existed within health authorities, with low-spending practices in high-cost authorities regularly spending more on drugs than highspending practices in low-cost authorities (Audit Commission, 1994).

The rationalization of prescribing was one of the many goals of the 1990 National Health Services and Community Care Act, which radically transformed the structure of public health care finance in the UK. Broadly speaking, resource allocation within the NHS prior to 1990 involved services being provided to patients, at zero or nominal prices, by

the appropriate health care professionals at the local level. Expenditure claims were remitted by these professionals to the Department of Health via the District Health Authority (DHA), in the case of hospitals, and the Family Health Services Authority (FHSA), in the case of GPS. Treatment decisions were thus effectively divorced from revenue decisions at the level of provision. The 1990 Act both introduced a decentralization of control to independent purchaser and provider units and began a transfer of public assets to not-for-profit organizations, thereby creating an 'internal market' for public sector health care (Le Grand, 1991). From 1991, independent, self-managed hospital Trusts began to emerge, these being secondary care suppliers which obtained their operating income from the sales of health care services to budget-holding purchasers. These purchasers included the existing DHAs, although the demand side of the market equation was increasingly supplemented by a new creation of the 1990 Act, the GP 'fundholder' (GPFH).

The introduction of fundholding has taken budgetary devolution and decision making as close to the patient as is deemed feasible in the UK. Once the status is approved, the fundholding practice is allocated an independent budget or fund by the health authority, from which it is at liberty to purchase a variety of medical services on behalf of its patients. Under the original terms of the fundholding scheme, these services included a specific list of elective inpatient procedures, most outpatient attendances, diagnostic investigations and all medicines and appliances prescribed by the practice. Assuming that the practice can meet the eligibility criterion of minimum list-size (number of registered patients), membership of the fundholding scheme is optional. However, the prospect of managing one's own budget appears to have proved attractive to many GPs because, within three years of the start of the scheme, almost one quarter of all English practices had joined (Comptroller and Auditor General, 1994). Surveys conducted during the introduction of fundholding suggested that GPFHs were anticipating a wide range of benefits from their new status, including the capacity to make efficiency gains, a more accessible service from local hospitals and freedom from administrative restrictions (Bain, 1993; Newton et al., 1993; Glennerster et al., 1994).

It is important to appreciate that the budget constraint imposed upon GPFHs was intended to be 'hard', in the sense that both penalties and benefits were entailed. Failure to comply with the conditions of fundholding, which included the requirement to manage the fund efficiency and effectively, would lead to the removal of recognition. Financial management of the practice would then revert to the health authority responsible for non-fundholders. Given that GPFHs were opting for their fundholding status voluntarily, it must be presumed that this sanction was perceived as carrying weight. With respect to benefits, any end-of-year savings from the budget were available for discretionary practice use, in the areas of patient treatment and convenience, practice management and the improvement of premises. These savings

could be accumulated over a period up to four years from the end of the year in which they were made (Statutory Instruments, 1991).

Although the finances of practices outside the fundholding scheme continued to be managed by the health authorities, it should be noted that the 1990 Act established indicative or target prescribing budgets for non-fundholders (NFHs). These were to be set by their governing authorities and, in this case, the prescribing budget constraint was 'soft' Operating over the budget entailed no financial penalty, and nominal surpluses were not available for use on the part of the NFHs which created them.

In this paper, we report on an analysis of the impact of fundholding on prescribing costs in one particular English D. K. Whynes et al. health authority. We begin with the construction of an exploratory regression model based on cross-section data, aimed at identifying factors significant in explaining prescribing cost variations between practices. Having found that, ceteris paribus, GPFHs are lower-cost prescribers, we then develop a behavioural model, consistent with our data, to explain why this might be the case. This explanation is based on the differential hardness of budget constraints faced by the different types of practice.

## FUNDHOLDING AND PRESCRIBING COSTS

Unlike his or her counterpart in, for example, the USA, the UK general practitioner possesses very limited scope in selecting the practice's clientele. Indeed, it is essentially the patient who selects the practice; any discrimination on the part of the GP would be likely to be considered unethical de facto (Sommerville, 1993). Previous studies of UK prescribing costs have tended to argue that, as GPs are required by the NHS to service the health care needs of the particular patients who have chosen to register with their practice, GP drug costs can be ascribed to exogenous, environmental factors over which they have little control. Thus, prescribing behaviour is seen to be conditioned by the prevalence of illness in the GPs' catchment areas, which, in turn, might be a function of the demographic and social structure of the practice's list of patients. A number of empirical studies have already concluded that certain of these environmental factors may be significant in explaining cost variations, for example, standardized mortality rates, relative deprivation and, especially, the demographic structure of GP lists (Baker and Klein, 1991; Forster and Frost, 1991; Morton-Jones and Pringle, 1993; Healey et al., 1994). Such studies possess two inherent weaknesses, however. First, most were conducted at the health authority level and practice-by-practice differences are likely to be submerged within the authority average. Second, and of greater significance, the studies cited were based on data collected before the advent of GP fundholding in 1991. Given that fundholding offers the GP scope for discretionary behaviour, over and above that conditioned by the environment, differences in prescribing between different practices may now be amenable to behavioural, i.e. economic, explanations.

Our primary data for analysis pertain to all general practices in the county of Lincolnshire, for calendar year 1993. At that time, Lincolnshire had 106 practices, 19 of which were fundholding. Two of the NFHs had originally entered the scheme but had been required to withdraw. Prescribing costs are conventionally measured as net ingredient cost (NIC), i.e. the cost to the NHS of the drugs prescribed, excluding dispensing fees and any discounts offered. The mean NIC per patient by practice was £76.8, with a standard deviation of £16.3 and a range of £40.9 to £125.7.

The data available permitted us to test a range of hypotheses within a single regression model. Following from the earlier research cited above, we began by postulating that certain patient and environmental characteristics might exert an impact upon practices' prescribing costs. First, we anticipated NIC per patient to be positively associated with the prevalence of FHSA-issued payment exemption certificates in the patient list. These exemptions are offered to those with a range of disabling medical conditions (such as diabetes or epilepsy), maternity cases and those holding prepayment certificates ('season tickets'). Patients in all these groups are inevitably extensive users of prescribed medication; indeed, this is why they hold such exemption certificates. Second, the disproportionate use of prescribed medicines by the elderly has been well documented (Griffin and Chew, 1990) and we accordingly included the proportion of practices' patients aged > 65 years as a potential explanatory variable. Third, certain practices, such as those in coastal resorts attracting holiday makers, regularly attract an influx of temporary residents. Temporary residents have a different prescribing demand from those on the regular list as they tend to consult a GP only when a prescription for medicine is required. A temporary resident variable was therefore included in the model. Similarly, a night visit to a patient leads more frequently to a prescription than does a normal consultation (Hallam, 1994), and we hypothesized that higher night visiting rates would be associated with higher prescribing costs. Fourth, we included each practice's institutional residents and the permanently sick (Census definition) in the regression equation, on the hypothesis that such individuals, exhibiting greater degrees of severity of illness, might entail higher costs of prescribing. Fifth, morbidity is known to vary with gender, and we hypothesized that the gender composition of the practice's list might influence its prescribing costs. Similarly, morbidity, and hence demand for prescriptions, is believed to be positively associated with poverty, as we included two measures of deprivation, namely, the Jarman score (Jarman, 1983; 1984) and the practice-specific unemployment rate.

Given that it is believed that patient consultation rates (and, by implication, prescription rates) vary with distance to the surgery (Whitehouse, 1985), we included three indicators of spatial location. These were, first, GPs' rural practice payments (which are calculated on the basis of the geographic dispersion of the practice's patients), second, the number of proximate practices (higher in densely-populated urban areas) and, third, the number of branch surgeries operated (more of such surgeries presumably making

patient access easier). If the deterrence effect of accessibility operates, prescribing costs might be expected to be lower in rural locations without branch surgeries. In addition, we considered the distance from surgery to hospital as a variable, hypothesizing that GPs distant from hospitals might be more inclined to treat rather than refer patients, with a positive impact on prescribing costs.

In contrast with these environmental variables over which the practice will have minimal control, there exist a number of organizational variables which the practice might seek to influence and which might reasonably be expected to exert an impact on prescribing costs. In particular, it is believed that 'over-prescription' of drugs may occur in practices experiencing workload pressure, in that, under such circumstances, GPs would have less capacity to accurately assess the need for a prescription on a consultationby-consultation basis (Harris et al., 1990). We included three variables as proxies for workload pressure, namely, the average list-size and the amount of management and nonmedical labour input to the practice. We also included, as a dummy variable, whether or not the practice was approved for training recently graduated physicians. Because such approval implies that the practice is, in the eyes of the health authority, well managed, we hypothesized that such practices might exhibit superior prescribing cost control.

The establishment of practice-specific formularies has been advocated for some time, as a guide to the rational choice of drugs in the light of efficacy and cost information (Drury, 1990). We hypothesized that the possession of such a formulary (in essence, an agreed prescribing protocol) would contribute to lower prescribing costs. Similarly, it is known that sizeable cost differentials exist between generic and non-generic drugs. Indeed, the contribution of generic prescribing to lowering drug costs was explicitly recognized by the official introduction of the 'limited list' in 1985. This constrained GPs' powers of prescribing drugs in certain therapeutic categories, for example, laxatives, sedatives, antacids and cold remedies. Between 1979 and 1990, the proportion of UK prescriptions written generically by all GPS rose from 29 to 40% (Bloor and Maynard, 1993) and, since 1990, the scope of the limited list has been extended considerably (ABPI, 1993). A variable reflecting generic prescribing thus appeared in our model. Finally, we included a dummy variable for fundholding in our model, to test whether a fundholding effect would exist independently of the earlier hypotheses.

Table 1 presents the results of a regression analysis on our data, with NIC per patient as the dependent variable. A degree of multicollinearity is evidenced by the variance inflation factors (VIFs) for a number of the estimates in the initial model, this being especially acute in three cases. Collinearity in large models can be resolved by backward stepwise regression (Armitage and Berry, 1994), and Table 1 also presents the final model resulting from such a procedure. As may be seen, stepwise elimination substantially reduces the number of variables in the full model, suggesting strong

statistical support for only six of our original hypotheses. On the environmental side, patient age, temporary residents and payment exemptions exert positive effects on prescribing costs, while the possession of a formulary, increased generic prescribing and fundholding exert negative effects. Because generic prescribing and the use of a formulary appear in our equation independently from whether or not the practice is fundholding, it would seem reasonable to conclude that fundholding status is not a necessary condition for prescribing cost reductions as engineered by these means.

The final model points to an independent fundholding effect in lowering prescribing costs of the order of 8% when evaluated at the variable means. However, we have yet to identify the cause of this effect. We suggest that the necessary theoretical argument revolves around the proposition that, with the acquisition of fundholding status, the budget constraints imposed upon GPs change from soft to hard. The next section presents a theoretical model of budget hardening, which yields predictions about GPFHs' prescribing behaviour in relation to that of NFHs. The predictions are then tested against our Lincolnshire data.

## A THEORY OF HARD BUDGET CONSTRAINTS

Although an integral part of the overall fund, the prescribing budget of GPFHs is calculated independently, with reference both to historic costs and local needs. GPs are required by their health authorities to deliver the care needed to maintain the health of those patients for whom they have assumed responsibility. The regulations pertaining to the use of budget surpluses deny the GPFH any personal profit and require that they be directed to the development of patient services. We follow convention in assuming that GPs allocate their prescribing budget to maximize utility, although, in our case, the GP's utility function can contain only arguments which derive from the GP's subjective valuations of patient welfare. For a GPFH, such patient welfare can be generated in one of two ways, first, by the prescription of medication and, second, by the transfer of surpluses from the drugs budget to other practice services. The GPFH will perceive that improvements in patient health state can be obtained by increasing the volume of drugs prescribed (i.e. the number of items) although, as the purchase of more items will entail higher costs, such improvements will be at the expense of savings from the budget, and thus health gains in other forms. We assume that the GPFH's indifference map will be of a conventional shape, implying a willingness to exchange health gains from prescribing for budget savings and concomitant health gains elsewhere.

## Table 1. Determinants of net ingredient cost per patient

| Variable | Full model β | VIF | T-ratio | Final model β | VIF | T-ratio |
|---|---|---|---|---|---|---|
| Proportion of prescriptions carrying payment-exemption certificates (%) | 2.58 | 2.10 | 1.93 | 3.59 | 1.03 | 3.91 |
| Patients aged ≥ 65 years (% of list) | 1.30 | 2.63 | 3.51 | 1.38 | 1.40 | 5.25 |
| List inflation caused by temporary residents (% over nominal list) | 0.32 | 3.65 | 2.13 | 0.34 | 1.39 | 3.72 |
| Night visits made per 3 months per 1000 patients | 172.16 | 1.95 | 1.34 | — | — | — |
| Proportion of patients resident in care institutions (%) | — | 1.12 | –0.20 | — | — | — |
| Proportion of list declared ‘permanently sick’ (%) | –1.36 | 11.44 | –0.42 | — | — | — |
| Proportion of patients which are female (%) | –0.01 | 1.53 | –0.02 | — | — | — |
| Rural practice payment per GP | 8.60 | 3.20 | 0.95 | — | — | — |
| Number of other practices within 1-mile radius | –0.22 | 3.11 | –0.22 | — | — | — |
| Number of branch surgeries operated | 0.41 | 1.73 | 0.34 | — | — | — |
| Miles from surgery to hospital | 0.06 | 2.20 | 0.21 | — | — | — |
| Jarman deprivation score | 0.11 | 9.25 | 0.36 | — | — | — |
| Unemployment (%) | 0.34 | 21.47 | 0.23 | — | — | — |
| Patients per GP on list | 0.00 | 2.95 | 0.68 | — | — | — |
| Management hours per GP | 0.18 | 1.49 | 1.40 | — | — | — |
| Non-medical hours per GP | 0.03 | 2.08 | 0.51 | — | — | — |
| Training practice? (1 = yes, 0 = no) | –2.65 | 1.21 | –1.00 | — | — | — |
| Does the practice use a formulary? (1 = yes, 0 = no) | –5.25 | 1.24 | –2.23 | –4.88 | 1.02 | –2.33 |
| Generics drugs prescribed (% of all items) | –3.74 | 1.80 | –0.40 | –1.39 | 1.79 | –4.89 |
| Fundholding? (1 = yes, 0 = no) | –6.51 | 1.52 | –1.92 | –6.75 | 1.10 | –2.39 |
| Constant | 44.16 | — | 1.06 | 52.64 | — | 7.13 |
| **Adjusted R-squared** | **0.56** | | | **0.58** | | |

Figure 1 portrays the basic model. All the four axes are measured 'per patient' and patients are assumed to be homogeneous. The north-east quadrant contains a health care production function (PF1), relating the number of drug items prescribed to the GP's perception of a patient's health status as it results from prescription medicines. Diminishing returns prevail, as is generally assumed to be the case with health care production functions (Wagstaff, 1986). Indeed, a point could be reached beyond which the GP believes that further prescribing would actually lead to a deterioration in health state. The south-east quadrant relates the number of items to the total cost of prescribed drugs, via cost per item or unit cost (UC1). We assume that the individual practice is small in relation to the drugs market and that GPs are therefore price-takers. The prevailing unit cost of drugs thus results from negotiations between the NHS and the pharmaceutical companies. The budget constraint, AB, appears in the south-west quadrant and possesses a slope of unity - each additional pound spent on drugs lowers the potential budget surplus by one pound. These three constructions now permit us to map, in the north-west quadrant, a utility possibilities frontier, UP1, which departs from the budget surplus axis at A and joins the health status axis at Z, the maximum available health status obtainable from prescribing.

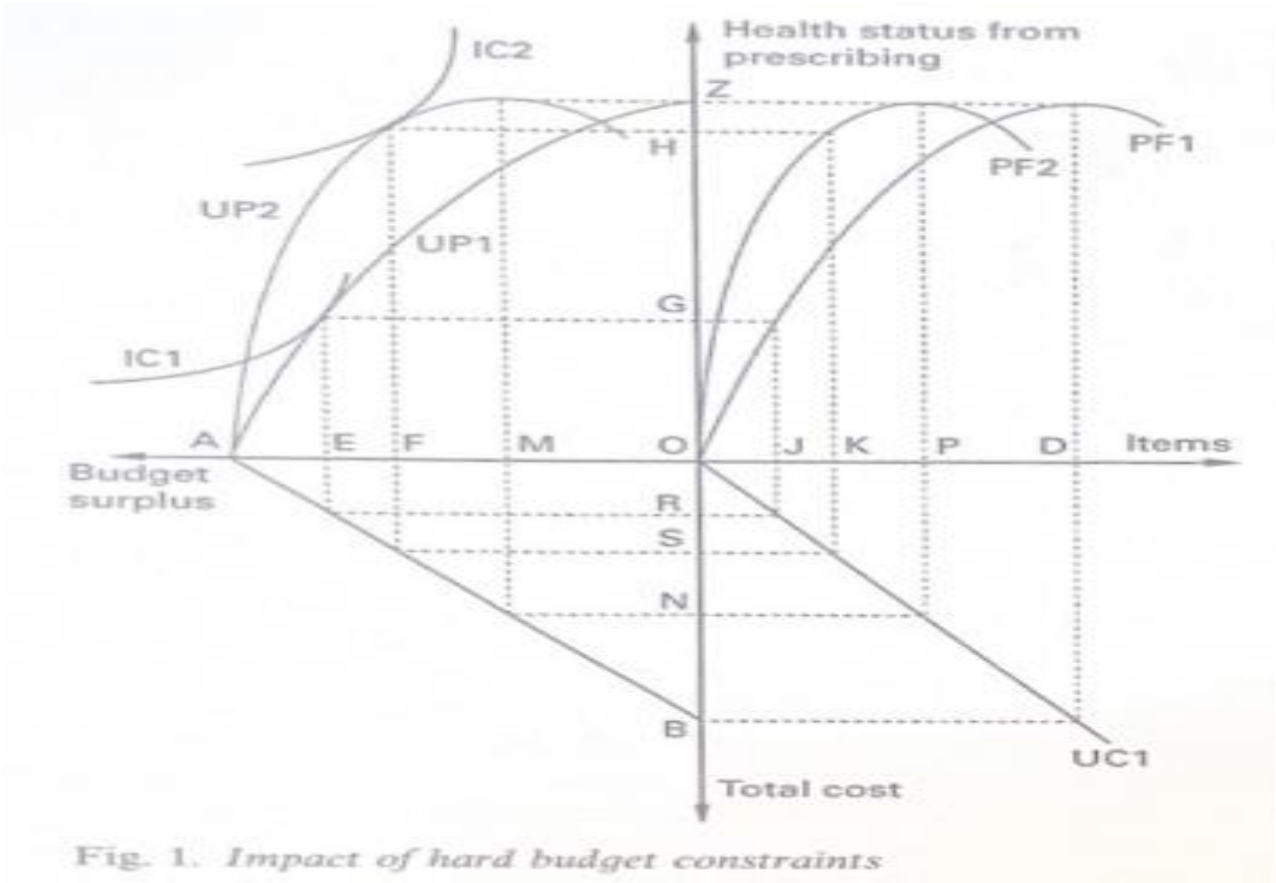

Fig. 1. *Impact of hard budget constraints*

Consider, first, a world such as that existing prior to 1990. Budget surpluses are not defined because funds are not in existence. Instead, the pre-fundholding GP prescribes only on the basis of expected health gain from drugs, and resources are provided by the

health authority to cover all necessary costs. In such a case, the GP's indifference curve in the north-west quadrant is horizontal and he or she would rationally prescribe OD items, corresponding to the point of maximum health, Z. Financial resources of an amount B are just sufficient to permit this amount of prescribing at the prevailing unit cost, UC1. Now consider the impact of the introduction of fundholding with a hard budget constraint, represented by the line AB. On the basis of the behavioural assumptions noted above, the GPFH's indifference curve becomes negatively sloped. With the remaining conditions as above, the optimal position for the GPFH is defined by the tangency of the indifference curve, IC1, and UP1. At this optimum, the GPFH is prescribing OJ items per patient at a total cost per patient of OR, and is thereby trading off a potential health gain from prescribing, GZ, for a budget surplus per patient, OE. The indifference curve of a GPFH placing a greater weight on budget surpluses would be more vertical than the one portrayed; the equilibrium would be at a prescribing health level lower than OG, at a budget surplus level higher than OE.

The model predicts that, in comparison with NFHs, GPFHs will prescribe a smaller number of items per patient at a lower total cost per patient. The cost per item prescribed will be the same for both groups. As may be seen from the data in Table 2, this theoretical result is supported by the observed facts in Lincolnshire.

## IMPROVING THE OPTIMUM SOLUTION

The model above pre-supposes no strategic response on the part of the GPFH as the budget constrain hardens. Such a response, however, is quite likely. We shall suppose that, in the presence of soft budget constraints, the production function, PF1, embodies degrees of X-inefficiency, i.e. it is not the most technically-efficient production function. X-inefficiency arises because the GP's assessment of PF1 will inevitably be based upon limited information and, in an unconstrained world, the GP faces no particular economic incentive to improve his or her information set. In contrast, a hard budget constraint creates the incentive for the GPFH to more accurately assess the impact of prescribing on patient health status.

**Table 2. Fundholders (GPFHs) versus non-fundholders (NFHs): means and differences**

| | NFHs | GPFHs | Difference | 95% CI | p |
|---|---|---|---|---|---|
| Mean NIC per patient (£) | 78.99 | 66.69 | 12.29 | 4.42–20.17 | 0.00 |
| Mean NIC per item (£) | 7.15 | 7.45 | –0.30 | –0.70–0.09 | 0.12 |
| Mean items per patient | 11.18 | 8.95 | 2.22 | 1.41–3.04 | 0.00 |

Suppose that, on the basis of superior information, the GPFH comes to believe that a given patient health status from prescribing could actually be achieved by prescribing

fewer items. Returning to Fig. 1, PF2 represents a production function in which a degree of such X-inefficiency has been eliminated (the method by which such elimination can occur will be clarified shortly). UC1 is assumed to remain unchanged, as is consistent with the evidence of Table 2. Using the equivalent construction to that of Fig. 1, PF2 gives rise to the utility possibilities frontier, UP2. Compared with the optimum identified previously, the reduction of X-inefficiency would, in this particular case, produce a new optimum with higher patient health status, OH, and lower budget surplus, OF, but at a higher overall utility level, IC2. The number of items prescribed per patient, and the total cost per patient, are OK and OS, respectively. Although these are larger than the corresponding levels in the earlier case, they are still lower than those for GPs facing soft budgets and are therefore consistent with the data presented in Table 2. It should be noted that this model also encompasses the possibility of a horizontal indifference curve on the part of the GPFH, in which case the minimum budget surplus of OM would accrue.

In practical terms, the reduction of X-inefficiency in prescribing can be addressed in two ways. First, it will be important for the GPFH to possess the capacity to translate data into operational management information. X-inefficiency will be easier to identify and control if prescribing is the subject of routine computerized monitoring and if a comprehensive and accurate audit of patient morbidity is available. Although all GPs, fundholding or otherwise, are offered substantial subsidies for computer purchases, of both the hardware and software variety (Ellis and Chisholm, 1993), we would expect that GPFHs would be more likely than NFHs to computerize their prescribing management. For our sample of Lincolnshire practices in 1993, 78.9% of GPFHs routinely monitored their prescribing budget using the practice computer, as opposed to 25.4% of NFHs ($y^2 = 27.64$, $p = 0.00$). Similarly, 68.4% of GPFHs, as opposed to 35.6% of NFHs, kept computerized records of practice morbidity ($x^2 = 6.91$, $p = 0.01$).

Second, reductions in X-inefficiency can, in effect, be purchased via substitutions in the prescribing input mix. It has been argued that a large proportion of the drugs most effective in the management of serious illness has been discovered over the past three decades, yet the prescription of these drugs has not always kept pace (McGavock, 1993). It has been shown, for example, that of the 50 most comD. K. Whynes et al. monly prescribed products in the NHS in 1991, 88% had been originally introduced at least a decade earlier (Griffin, 1994). Although extremely effective, recently introduced drugs are typically expensive in relation to the older medicines, as they remain protected by patents. Where patents have expired, however, generic or unbranded drugs are available, which have identical pharmacological effects to the branded variety. Generic medicines are cheaper substitutes of the branded products; up to ten-fold cost differentials have been identified (Strube, 1993).

Given the diversity of patient needs, GPs will typically prescribe a combination of older and newer drugs to generate patient health. From the point of view of a budget constrained GPFH, increasing the proportion of newer, more effective, more expensive drugs will effect the shift in the production function required by Fig. 1 - a given perceived health status will result from fewer items as each item is deemed more efficient. Unfortunately, unit costs will correspondingly have to rise, entailing higher total costs and a smaller budget surplus, and the net welfare-enhancing effect could therefore be reduced. It would, however, be possible for a GP to increase the rate of generic prescribing of substitutable medicines and use the resources so saved to purchase newer medicines with improved therapeutic potential. In consequence, the average unit costs of prescribing would remain the same (as required by the data of Table 2), although perceived patient health status would rise (producing the specified production function shift in Fig. 1). For this explanation to be plausible, a significant difference in the rate of generic prescribing must be observable between GPFHs and NFHs. For Lincolnshire, the GPFHs' rate of generic prescribing in 1993 was 43.3%, compared with the NFHs' 34.8%, a difference of 8.54% (95% confidence intervals of 2.11 to 14.96, $p = 0.01$).

## CONCLUSIONS

Regression analysis of the prescribing data available for Lincolnshire indicate that both environmental and behavioural factors contribute to an explanation of variations in prescribing costs. In comparison with NFHs, GPFHs exhibit (i) lower NICs per patient, (ii) lower items prescribed per patient, (iii) similar unit costs, (iv) greater usage of computers in prescribing management and (v) a higher rate of generic prescribing. All these facts are consistent with a behavioural model in which perceived patient health gains from prescribed medicines are being traded off against budget savings, with GPFHs attempting to eliminate X-inefficiency by improved prescribing management. At the core of this model lies the replacement of soft by hard budget constraints.

One important caveat in the model must be addressed. Given that the GPFH is the decision maker, the optimum selected is determined by his or her perception of patient health status resulting from both prescribing and from alternative uses of the budget surplus. Whether or not this perception is objectively correct is a moot point. It would be quite possible for that which the GP perceives as a beneficial trade-off between prescription medicine and the budget surplus to turn out, in reality, to be health-reducing from the patients' point of view. Unfortunately, we shall be unable to resolve this issue until well into the future, when morbidity data become available to assess the wisdom of earlier clinical judgements.

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